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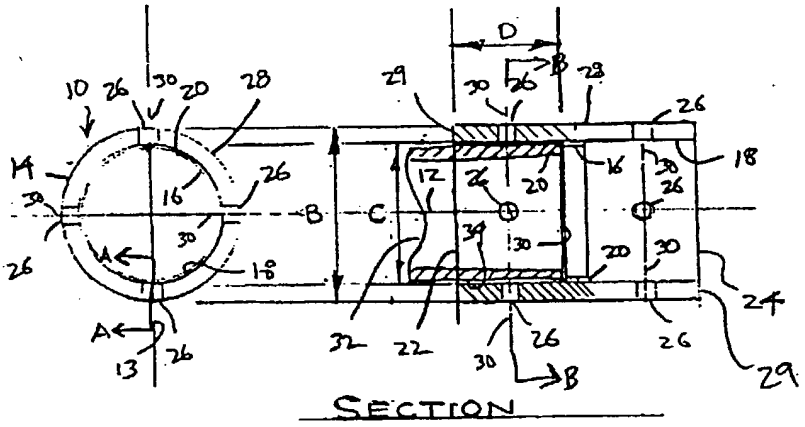

(57) Abstract

A method and apparatus for forming a tubular joint. The tubular joint is between a fitting (10) and a tubular conduit (32), which have mating surfaces with a small space therebetween. One or the other, or both, of the fitting (10) and the tubular conduit (32) have a groove (36) formed on its respective mating surface. The groove can be continous or a segment. One or the other of the fitting (10) or the tubular conduit (32) has a plurality of holes (26) formed therein. At least some of the holes are for injection of a tubular joint adhesive into the tubular joint, and the rest of the holes are for the passage of the tubular joint adhesive out of the small space therebetween. Injection of the adhesive can be facilitated by an apparatus for connecting the mating surface of the fitting to the mating surface of the tubular pipe by means of the tubular joint adhesive. The apparatus uses a piston (58) and cylinder assembly (46) to compressive inject the adhesive into at least one of the holes until the adhesive passes through the space between the fitting and the tubular conduit and out of another of the holes. The apparatus can be set to deliver a calibrated amount of the adhesive, so that sufficient adhesive can be delivered to the joint without being wasteful of the adhesive.

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METHOD AND APPARATUS FOR FORMING A TUBULAR JOINT

Field of the Invention

This invention relates generally to tubular joints, and more particularly, to a method and apparatus for forming joints between tubular fittings and tubes.

Background of the Invention

Transportation of fluids, such as water and compressed gases, and of vacuums, is generally accomplished by means of tubular conduits, such as pipes, that run from an originating point to a destination point. Typically any particular path that the tubular conduits follow is generally only a portion of a network of conduits that includes tubes of differing sizes. Also, the path is generally not a straight line. Accordingly, a large variety of fittings has been developed to allow the tubular conduit to be made a part of the network of conduits and, in the case that the tubular conduits are not flexible, to allow the path to turn corners in order to be as direct yet nonintrusive as possible.

In the past it has been known to use threaded pipes and fittings to construct the tubular conduits. However, more recently, non-threaded tubes and fittings have been used, with the fittings being attached to the tubes by means of a material having adequate adhesive properties to prevent leaks. For example, copper tubing and copper fittings can be soldered together ("sweated") to produce the desired tubular conduit. Even more convenient than copper tubing and fittings, however, are the plastic tubing and fittings that are now commonly

available.

The plastic tubing and fittings can be made from a variety of materials, such as acrylonitrile-butadiene-styrene (ABS), polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC). Tubes made from these materials can be accurately and cleanly cut to the desired lengths with simple tools. The tubes are generally smooth-walled and circular in cross-section, and the fittings have inner surfaces that fit closely to the outer dimensions of the tubing, so that when they are engaged without an adhesive, at most only a small gap exists between the tube and the fitting.

After cutting the tubes and appropriately choosing the fittings, the tubes and fittings can be easily and quickly assembled and cemented together with manually applied layers of a chemical adhesive. Generally, the smooth outer wall of the tube is coated with a layer of the adhesive around the entire perimeter of the end of the tube to which the fitting is to be attached and the fitting is then placed over the end of the tube with the adhesive applied. Depending upon the adhesive system used, it is sometimes recommended that the fitting be given a small circumferential twist after it is assembled on the tube.

A significant problem with tubing-adhesive assembly system known in the prior art is that it is difficult for the user to both 1) gauge the proper amount of adhesive that must be applied and 2) determine that the adhesive is properly administered in the fitting. It is important to apply the proper amount of adhesive to a fitting in order to assure that there is neither

too little nor too much adhesive applied. If there is too little adhesive, the joint between the tubing and the fitting is likely to leak, either immediately or after a period of time. If there is too much adhesive, the result is a joint that looks messy and the likelihood that the adhesive gets on the user's skin and clothing, and generally promotes unclean working conditions. It is also important for the user to be assured that the adhesive has been applied around the circumference of the tubing without leaving any gaps, so that the user can be assured that it will not be necessary to drain the tube and repair a leak that would otherwise have been detected first.

It has specifically been known in the prior art to for a circumferential recess in a fitting for the circumferential sealing of the fitting against a pipe. Furman et al., in U.S. Patent No. 1,946,619, disclose the formation of a circumferential recess in the inner surface of a fitting, with a plurality of bosses or projections on the outer surface. The bosses or projections are located longitudinally over the placement of the circumferential recess. In use, the fitting disclosed by Furman et al. is attached to the pipe to which it should be sealed. If later, after the fitting is in place, the fitting should develop a leak, one of the bosses or projections is drilled out to form a hole from the outer surface of the fitting to the circumferential recess directly beneath, and a sealing material is introduced therein through the drilled-out hole. It is desirable that the sealing material flow around the entire circumferential recess to increase the likelihood that the leak will be sealed. However, Furman et al. do not disclose any

mechanism or manner whereby the users of their invention can be assured that the sealing material has flowed around the entire circumferential recess.

In U.S. Patent No. 3.977,704, Meyer discloses a pipe coupler for connecting two sections of pipe to prevent the escape of gas from within the pipe through the joint therebetween. An annular coupling member comprises two end sections and an intermediate section therebetween, with the two end sections having an inside diameter substantially the same as the outside diameter of the pipe section, while the inside diameter of the intermediate section is greater. The two pipe sections are disposed within the coupling member, with the joint positioned longitudinally within the intermediate section. The two pipe sections and the intermediate section form an annular space therebetween, and in the annular space is positioned an annular sealing gasket. The sealing gasket has an inside diameter substantially the same as the pipe outside diameter, and has a radially outwardly extension positioned therearound. The intermediate section has a pair of spaced apart opening and filling plugs are sealingly disposed within these opening, and the plugs extend inwardly into the annular space. The gasket outwardly extension is positioned between the filling plugs. An adhesive sealant is disposed within, and substantially fills the annular space between the gasket and the coupling member. The adhesive sealant, which enters the annular space through the filling plugs, compresses the gasket against the two pipe sections to seal the pipe joint therebetween. Also included are means for preventing the sealant from leaking out of the annular space through the filling plugs.

Although Meyer discloses a means for separately filling the two annular spaces in the pipe coupler, the fact that an annular space has been completely filled with a sealant is not known until the sealant escapes through the small gap between the inside diameter of the end section and the outside diameter of the pipe section. Accordingly, it is necessary to apply the sealant under high pressure to cause the sealant to escape through the small gap between the end section and the pipe section.

Lavender et al., in U.S. Patent No. 4,434,125, disclose a wear sleeve having tapered ends. The wear sleeve is secured to a drill pipe by placing tapered split seal rings adjacent the ends of the sleeve to seal the annulus between the sleeve and pipe. Next, exothermically polymerically setting liquid epoxy plastics material is introduced into the annulus via a long elastomeric riser tube pushed into an inlet port in one seal ring until the epoxy rises well into another long elastomeric rise tube pushed into an exit port in the other seal ring. Meanwhile the interior of the pipe within the sleeve is heated to, for example, 150 degrees F by blowing hot air through the pipe, and when the plastics material has set, rotating the riser tubes about their axes to break off the sprues, and removing the riser tubes and seal rings. Because the epoxy is a liquid, both of the riser tubes must be located on the upper portion of the apparatus disclosed by Lavender et al. Otherwise, the epoxy would run out, or otherwise not work properly by allowing air and gas to escape through the risers.

Tani et al., in U.S. Patent No. 4,588,467, disclose filling

an annular groove in a stator for a rotating electric machine with adhesive through an inlet port. The adhesive passes to an outlet port, which is isolated from the inlet port by a dam formed in the annular groove. As the adhesive is forcibly introduced into the annular groove through the inlet port, it travels substantially along the annular groove until it reaches the outlet port. Aside from this art being nonanalogous because of its field of application, the adhesive can travel in substantially only one direction along the groove from the inlet port to the outlet port. This quite possibly leaves a gap in the adhesive between the inlet port and the dam and/or between the outlet port and the dam, at which point the adhesive seal is incomplete, rendering the resulting ring of adhesive less than entirely suitable.

In U.S. Patent No. 3,491,182, Hunder et al. disclose a method of bonding a casing to a pipe using engageable sleeves. At least one of the sleeves has two longitudinally separated openings. The open ends of the engageable sleeves are plugged with putty after the sleeves are engaged around the pipe. Then sealant is supplied through one of the openings, causing bubbles and, eventually, the sealant to escape through the other opening. However, utility of the Hunder et al. invention is only dependent upon the proper installation of the putty, because if the putty is not installed, the sealant will preferentially leak out through the open ends of the engageable sleeves rather than through the other opening.

Siler, in U.S. Patent No. 3,480,964, discloses tensioning an annular disk inside a cylindrical enclosure by using nozzles

inserted into alternate holes in the circumference of the enclosure to inject adhesive material simultaneously into a circumferential groove while using the other holes in the circumference of the enclosure as pressure relief vents.

However, none of these above references, or any other references of which the Applicant is aware, disclose injecting an adhesive or sealant through one or more of a plurality of holes into a gap between a tubular pipe and a fitting, where the gap has sufficient space to allow the adhesive or sealant to pass substantially unimpeded through the gap and out of another hole, without the need to also take other steps. These other step could be, for example, either to use high pressure when applying the adhesive or sealant or to plug gaps between the fitting and the pipe through which it is desired that the adhesive or sealant will not pass.

According to the comments above, it would be advantageous to have a method and apparatus for applying adhesive to a joint that would apply the proper amount of adhesive to proper places in the joint without the need to take additional steps to prevent the leakage of the adhesive from undesired locations or the need to apply the adhesive with special equipment such as high pressure equipment.

Summary of the Invention

According to one aspect, the invention is a method for connecting a surface of a fitting to a surface of a tubular pipe by means of an adhesive. The surface of the fitting is capable of mating with a portion of the surface of the tubular pipe, with sufficient space in a gap therebetween for easy passage of the

adhesive. The method comprises the steps of a) forming at least two holes in the fitting and/or the tubular pipe, each of the holes passing through the gap and connecting the surface of the fitting and/or the tubular pipe with another surface of the fitting and/or the tubular pipe; b) connecting the fitting with the tubular pipe; and c) causing the adhesive to pass into at least one, but not all, of the holes until a portion thereof passes substantially unimpeded through the gap between the mating surface of the fitting and the mating surface of the tubular pipe and out of at least another one of the holes.

In another aspect, the invention is an apparatus for connecting a surface of a fitting to a surface of a tubular pipe by means of an adhesive. The surface of the fitting is capable of mating a portion of the surface of the tubular pipe, with sufficient space in a gap therebetween for passage of the adhesive. The fitting and/or the tubular pipe have at least two holes therein. Each of the holes connects a surface of the fitting and/or tubular pipe with another surface of the fitting and/or tubular pipe. The apparatus comprises a fixture to cause the adhesive to pass into at least one, but not all, of the holes until a portion thereof passes substantially unimpeded through the gap between the surface of the fitting and the surface of the tubular pipe and out of at least another one of the holes.

Brief Description of the Drawings

Figure 1A is a transverse cross-sectional view of a first embodiment of a plastic tubing coupling, in accordance with an aspect of the invention.

Figure 1B is a longitudinal cross-sectional view of the

first embodiment of the plastic tubing coupling, taken along the vertial plane of symmetry shown in Figure 1A.

Figure 1C is a longitudinal cross-sectional view of a portion of a second embodiment of the plastic tubing coupling shown along the section A shown in Figure 1A.

Figure 1D is a longitudinal cross-sectional view of a portion of a third embodiment of the plastic tubing coupling shown along the section A shown in Figure 1A.

Figure 2A is a first elevational view of an apparatus according to the present invention.

Figure 2B is a second elevational view of the apparatus shown in Figure 2A, according to the present invention.

Figure 3A is a transverse cross-sectional view of a first embodiment of a burnishing tool for use with the invention.

Figure 3B is a longitudinal cross-sectional view of the first embodiment of the burnishing tool, taken along the vertial plane of symmetry shown in Figure 3A.

Detailed Description of the Preferred Embodiment

Figure 1A is a transverse cross-sectional view of a first embodiment of a plastic tubing coupling, in accordance with an aspect of the invention, and Figure 1B is a longitudinal cross-sectional view of the first embodiment of the plastic tubing coupling, taken along the vertical plane of symmetry shown in Figure 1A.

The plastic tubing coupling 10 is intended to be an exemplary fitting of the type for use with various tubings, such as plastic tubings and metal tubings. The coupling 10 is generally a thin circular cylinder in shape, and has a

longitudinal axis 12, which defines its transverse circular symmetry. The walls 14 of the coupling 10 are uniformly thick in the radial direction and extend along the longitudinal axis 12 an equal distance from a circumferential ridge 16 that is formed in an inner surface 18. The circumferential ridge 16 has two small transverse annular walls 20 which extend radially inward from the inner surface 18 and serve as end stops to circular tubing which is inserted into the coupling 10 through either of the openings 22 or 24.

Up to this point, the detailed description has included features that are found in couplings and other fittings known in the prior art. In addition to these prior art features, the coupling 10 has two pluralities of holes 26 that extend between the inner surface 18 and an outer surface 28 of the coupling 10. One plurality of the holes 26 is located on the left hand side of the coupling 10 and the other plurality of the holes 26 is located on the right hand side of the coupling 10. Each of the holes 26 has an axis of symmetry 30 and can be formed in the coupling 10 in any conventional manner, such as drilling or even casting. As shown in Figure 1B, the axes of symmetry 30 of each plurality of holes can be located in the same plane, that is perpendicular to the longitudinal axis 12. Alternatively, the holes 26 can be formed at different longitudinal positions along the inner and outer surfaces 18 and 28 of the coupling 10. Generally speaking, however, the holes 26 are located approximately longitudinally equidistant from the annular wall 20 and the end 29 of the coupling 10.

The number of holes 26 in each of the pluralities of holes

can be varied, as can their circumferential spacing. For exemplary purposes, the four holes 26 in the view of Figure 1A are spaced 90 degrees apart. If more holes 26 are desired, they can be spaced uniformly or nonuniformly.

In use, the coupling 10 receives the squared-off end 30 of a tube 32. The outer surface 34 of the tube 32 has a very slightly smaller diameter than the diameter of the inner surface 18 of the coupling 10, so that there is a very small clearance between the outer surface 34 and the inner surface 18. After the tube 32 has been placed in one of the openings 22 or 24 and forced longitudinally until it bottoms out against the annular wall 20, the proper adhesive is injected into at least one of the holes 26, in a manner to be described subsequently, until a portion of the injected adhesive begins to exit through each of the holes 26 through which the adhesive is not being injected. This will assure that the injected adhesive has moved from an injection hole 26 to the exit holes 26, thereby completely sealing the joint between the coupling 10 and the outer surface 34 of the tube 32.

In practice, each plurality can consist of an even number of holes 26 and half of them can be used to inject the adhesive, with the other half serving as exit holes 26 to signal that the amount of the adhesive that has been injected is adequate to seal the joint between the coupling 10 and the outer surface 34 of the tube 32. Further, it may be preferable for the injection holes 26 to alternate circumferentially with the exit holes 26.

Figure 1C is a longitudinal cross-sectional view of a portion of a second embodiment of the plastic tubing coupling 10

shown along the section A shown in Figure 1A. This section is identical to that shown in Figures 1A and 1B, except that the holes 26 are joined by a groove 36 that connects at least one injection hole 26 with at least one exit hole 26. The groove 36 has a rectangular cross-section and is of such a size and shape that it allows any adhesive injected thereinto to pass through substantially unimpeded until it passes out of at least one exit hole 26 without substantial pressure being applied to the adhesive. For example, it is possible that the adhesive could be applied with conventional manually operated tube applicators that are presently used to apply caulk and other sealants and adhesives to cracks. If the pluralities of holes lie in a plane that is perpendicular to the longitudinal axis 12, the groove 36 can lie in the same plane. Generally, all of the injection holes 26 and the exit holes 26 will be joined by the same groove 36, which will be located in a plane perpendicular to the longitudinal axis 12.

Similarly to Figure 1C, Figure 1D is a longitudinal cross-sectional view of a portion of a third embodiment of the plastic tubing coupling shown along the section A shown in Figure 1A. This section is identical to that shown in Figures 1A-C, except that the holes 26 are joined by a groove 38 that connects at least one injection hole 26 with at least one exit hole 26. The groove 38 has a triangular cross-section. As in the discussion of groove 36, in Figure 1C, groove 38 is of such a size that it allows any adhesive injected thereinto to pass through substantially unimpeded until it passes out of at least one of the exit holes 26. If the pluralities of holes lie in a plane

that is perpendicular to the longitudinal axis 12, the groove 36 can lie in the same plane. Generally, all of the injection holes 26 and the exit holes 26 will be joined by the same groove 38, which will be located in a plane perpendicular to the longitudinal axis 12.

A groove connecting at least one injection hole 26 and at least one exit hole 26 can have any desired cross-sectional shape. The grooves 36 and 38 are shown only for exemplary purposes. The primary requirement concerning such a groove is that it is of such a size and shape that it allows any adhesive injected thereinto to pass through substantially unimpeded until it passes out of at least one exit hole.

If the coupling 10 includes any circumferential groove such as groove 36 or groove 38, the adhesive injected through an injection hole 26 will preferentially move around the groove substantially unimpeded until it is forced from one of the exit holes 26. Because of the close gap at the end of the fitting, the adhesive will appear out the holes before it comes out the gap. Generally, this will not happen until all of the circumferential groove is filled with adhesive, so that the fact that the adhesive is exiting from each of the exit holes 26 can be taken as a signal that there exists a complete circumferential bead of the adhesive between the inner surface 18 of the coupling 10 and the outer surface 34 of the tube 32.

While the foregoing detailed description relates to fittings having inner surfaces that fit over outer surfaces of tubular conduits, it will be apparent to those skilled in the arts related to this invention that the fittings could be of the sort

having outer surfaces which fit inside inner surfaces of a tubular conduit. Likewise, whereas the detailed description has related to the location of grooves on the inner surfaces of the described fittings, it will be apparent to those skilled in the related arts that the grooves could alternatively be formed on the outer surface of the tubular conduits or on both the inner surface of the fittings and the outer surface of the tubular conduits. Further, if the fittings are of the sort which have outer surfaces which fit into inner surfaces of a tubular conduit, the grooves could alternatively be formed on the inner surface of the tubular conduit or on both the inner surface of the tubular conduit and the outer surface of the fitting.

Figure 2A is a first elevational view of an apparatus according to the present invention and Figure 2B is a second elevational view of the apparatus shown in Figure 2A, according to the present invention. The apparatus 38 includes an injection body 40 and a pair of calipers 42 which are attached to the injection body 40 through sliding seals 44. The injection body 40 includes a cylinder assembly 46 having a wall 48 that defines a cylinder 50. The sliding seals 44 are attached to the wall 48 and allow the calipers 42 to swivel about the axes 52. A portion of the cylinder 50 encloses a captured piston 54 which fits closely against the inner wall 56 that defines the cylinder 50. The piston 54 is attached to a threaded piece 58, which extends upwardly through a threaded hole in an upper portion 60 of the wall 48. The threaded piece 58 is attached to a handle 62 which is shaped to be easily manipulated by a user.

The calipers 42 are hollow from where they attach to the

injection body 40 to their pointed ends 64. Therefore, the cylinder 50 communicates with the pointed ends 64 of the calipers 42 through the sliding seals 44. The cylinder 50 is filled with the adhesive which is used to inject the volume between the coupling 10 and the tube 32 (see Figures 1A-D). Turning the handle 62 in the proper direction about the axis 66 causes the piston 54 to decrease the volume of the cylinder 50, thereby causing the adhesive to move through the calipers 42 to their pointed ends 64. The pointed ends 64 of the calipers 42 can be swiveled about the axes 52 until they are pointed toward one another, and are in position to inject the adhesive into a pair of oppositely directed injection holes 26 in a coupling 10 (shown in phantom lines).

The threaded piece 58 has a known thread pitch. Therefore, each turn of the handle 62 can be calibrated to inject a known amount of the adhesive into the injection holes 26 of the coupling 10. If desired, the thread pitch of the threaded piece 58 can be chosen to produce a desired delivered volume with each complete turn of the handle 62.

The spacing between the pointed ends 64 of the calipers 42 can adjusted to accommodate a wide variety of diameters of the tube 32. Further, if desired, the pointed ends 64 of the calipers 42 could be fitted with special injectors that mate with the injection holes 26 in order to minimize any leaking of the adhesive. In other embodiments of the apparatus 38, the piston 54 can be forced through any conventional electric, hydraulic or pneumatic drive mechanism. Also, the apparatus 38 could easily be adapted to receive entire cans of the adhesive to be injected

through any of a variety of mechanisms that are known to those skilled in the art of adhesives handling and/or injection. The color of the adhesive can be chosen to contrast with the color of the plastic from which the coupling 10 and the tube 32 are made. For example, if the coupling 10 and the tube 32 are made from PVC or CPVC, the adhesive can be colored red, while if the coupling 10 and the tube 32 are made from ABS, the adhesive can be colored white.

Figure 3A is a transverse cross-sectional view of a first embodiment of a burnishing tool for use with the invention, and Figure 3B is a longitudinal cross-sectional view of the first embodiment of the burnishing tool, taken along the vertical plane of symmetry shown in Figure 3A. The burnishing tool 60 is generally circularly symmetric about a rotational axis 62. The burnishing tool 60 has a cutting portion 64 disposed at one longitudinal end and a driving portion 66 at the other end. The cutting portion 64 includes a plurality of (for example, two) longitudinally placed blades 68 formed in a cavity 70. The blades are generally uniformly placed. While the blades are most easily made fixed, they can also be retractable into the body of the cutting portion 64, out of the cavity 70, by conventional means well known to those skilled in the art.

At the driving end 66, there may be formed a square drive cavity 76 of a conventional size, so that the burnishing tool 60 can be driven with a drive mechanism such as a ratchet handle. Alternatively, the burnishing tool 60 can also be supplied with wings 78, which allow the tool's user to manipulate the burnishing tool 60 manually.

In operation, the burnishing tool 60 puts a slight taper on the end of a tube, such as tube 32 shown in Figure 1B. Preferably the taper is approximately 1 degree, which is exemplary of the taper required when casting cavities in fittings to allow the casting tool to be removed from the fitting. Using this burnishing tool will cause the end of the tube 32 to conform even more closely to the portions of the fitting which are longitudinally displaced from the circumferential groove 38. This makes it even more likely that the adhesive will flow substantially unimpeded through the groove 38 without passing through any gapes in the fitting, but rather only passing back out one of the exit holes 36 after the groove is entirely filled with adhesive.

The burnishing tool 60 can also be used to form a circumferential groove on the outside of the tube 32. This can be accomplished by causing the blades 68 to have a non-planar shape that will create the groove as the tool is turned around the tube 32 to perform the burnishing action. Putting a groove on the outside of the tube 32 will obviate the need to put a groove on the inside surface of a fitting, as is described above.

The presently preferred embodiments of the methods, apparatus and fittings of the present invention have been shown in the drawings and described in the foregoing detailed description. However, as discussed previously in part in this detailed description, those skilled in the pertinent arts will be able to produce further alternative embodiments which are within the scope of the present invention. Accordingly, the

scope of the present invention is determined solely by the following claims.

Claims

1. A method for connecting a surface of a fitting to a surface of a tubular pipe by means of an adhesive, the surface of the fitting being capable of mating with a portion of the surface of the tubular pipe, with sufficient space in a gap therebetween for easy passage of the adhesive, comprising the steps of:

a) forming at least two holes in the fitting and/or the tubular pipe, each of the holes passing through the gap and connecting the surface of the fitting and/or the tubular pipe with another surface of the fitting and/or the tubular pipe;

b) connecting the fitting with the tubular pipe; and

c) causing the adhesive to pass into at least one, but not all, of the holes until a portion thereof passes substantially unimpeded through the gap between the mating surface of the fitting and the mating surface of the tubular pipe and out of at least another one of the holes.

2. The method of claim 1 wherein step a) includes forming an even number of holes in the fitting and/or the tubular pipe.

3. The method of claim 1 wherein step c) includes causing the adhesive to pass into a circumferentially alternating set of holes in the fitting and/or the tubular pipe until a portion of the adhesive passes out of each of the remaining holes.

4. The method of claim 2, further comprising the step of forming a groove on the mating surface of the fitting and/or the tubular pipe, the groove forming the gap and connecting at least

one hole with another hole.

5. The method of claim 4 wherein the groove is a continuous groove connecting all of the holes.

6. The method of claim 5 wherein the groove is circumferential.

7. The method of claim 1, further comprising the step of forming a groove on the mating surface of the fitting and/or the tubular pipe, the groove forming the gap and connecting at least one hole with another hole.

8. The method of claim 7 wherein the groove is a continuous groove connecting all of the holes.

9. The method of claim 8 wherein the groove is circumferential.

10. A method for forming a joint between a fitting and a tubular pipe by means of an adhesive, comprising the steps of:

a) forming the tubular pipe, the tubular pipe having an outer surface;

b) forming the fitting, the fitting having an inner surface and an outer surface, a portion of the inner surface encompassing a portion of the outer surface of the tubular pipe in a gap with sufficient space therebetween for easy passage of the adhesive;

c) forming at least one inlet hole in the fitting for admission of the adhesive, the at least one inlet hole passing into the gap between the inner surface of the fitting and the outer surface of the fitting;

d) forming at least one outlet hole in the fitting for release of some of the adhesive admitted in the inlet hole, the

at least one outlet hole passing into the gap between the inner surface of the fitting and the outer surface of the fitting;

e) placing the fitting over the tubular pipe; and

f) causing an adhesive to pass into the at least one inlet hole until a portion thereof passes substantially unimpeded through the gap between the outer surface of the fitting and the inner surface of the tubular pipe and out of at least one of the outlet holes.

11. The method of claim 10 wherein step c) includes forming at least two inlet holes in the fitting and step d) includes forming at least two outlet holes in the fitting.

12. The method of claim 10, further comprising the step of forming a groove on the inner surface of the fitting, the groove forming the gap and connecting at least one inlet hole with at least one outlet hole.

13. The method of claim 12 wherein the groove is a continuous groove connecting all of the inlet holes with all of the outlet holes.

14. The method of claim 10 wherein step c) includes forming a plurality of inlet holes in the fitting and step d) includes forming the same plurality of outlet holes in the fitting, the locations of the inlet holes alternating circumferentially with the locations of the outlet holes.

15. The method of claim 14, further comprising the step of forming a groove on the inner surface of the fitting, the groove forming the gap and connecting all of the inlet holes with all of the outlet holes.

16. The method of claim 15 wherein the groove is a

continuous circumferential groove.

17. An apparatus for connecting a surface of a fitting to a surface of a tubular pipe by means of an adhesive, the surface of the fitting being capable of mating a portion of the surface of the tubular pipe, with sufficient space in a gap therebetween for passage of the adhesive, the fitting and/or the tubular pipe having at least two holes therein, each of the holes connecting a surface of the fitting and/or tubular pipe with another surface of the fitting and/or tubular pipe, the apparatus comprising a fixture to cause the adhesive to pass into at least one, but not all, of the holes until a portion thereof passes substantially unimpeded through the gap between the surface of the fitting and the surface of the tubular pipe and out of at least another one of the holes.

18. The apparatus of claim 17 wherein the number of holes in the fitting is even and the fixture of the apparatus causes the adhesive to pass into a circumferentially spaced set of holes in the fitting and/or the tubular pipe until a portion of the adhesive passes out of each of the remaining holes.

19. The apparatus of claim 18 wherein the circumferentially spaced set of holes in the fitting and/or the tubular pipe contains an even number of holes and the fixture of the apparatus causes the adhesive to pass into a first uniformly circumferentially spaced subset of the set of holes in the fitting and/or the tubular pipe until a portion of the adhesive passes out of each of the remaining holes in the set of holes.

20. An apparatus for connecting an inner surface of a fitting to an outer surface of a tubular pipe by means of an

adhesive, the inner surface of the fitting being capable of encompassing a portion of the outer surface of the tubular pipe, with sufficient space in a gap therebetween for passage of the adhesive, the fitting having at least two holes therein, each of the holes connecting the inner surface of the fitting with an outer surface of the fitting, the apparatus comprising means for causing the adhesive to pass into at least one, but not all, of the holes until a portion thereof passes substantially unimpeded through the gap between the outer surface of the fitting and the inner surface of the tubular pipe and out of at least another one of the holes.

21. The apparatus of claim 20 wherein the number of holes in the fitting is even and the apparatus comprises means for causing the adhesive to pass into a circumferentially spaced set of holes in the fitting until a portion of the adhesive passes out of each of the remaining holes.

22. The apparatus of claim 21 wherein the circumferentially spaced set of holes in the fitting contains an even number of holes and the apparatus causes the adhesive to pass into a first uniformly circumferentially spaced subset of the set of holes in the fitting until a portion of the adhesive passes out of each of the remaining holes in the set of holes.

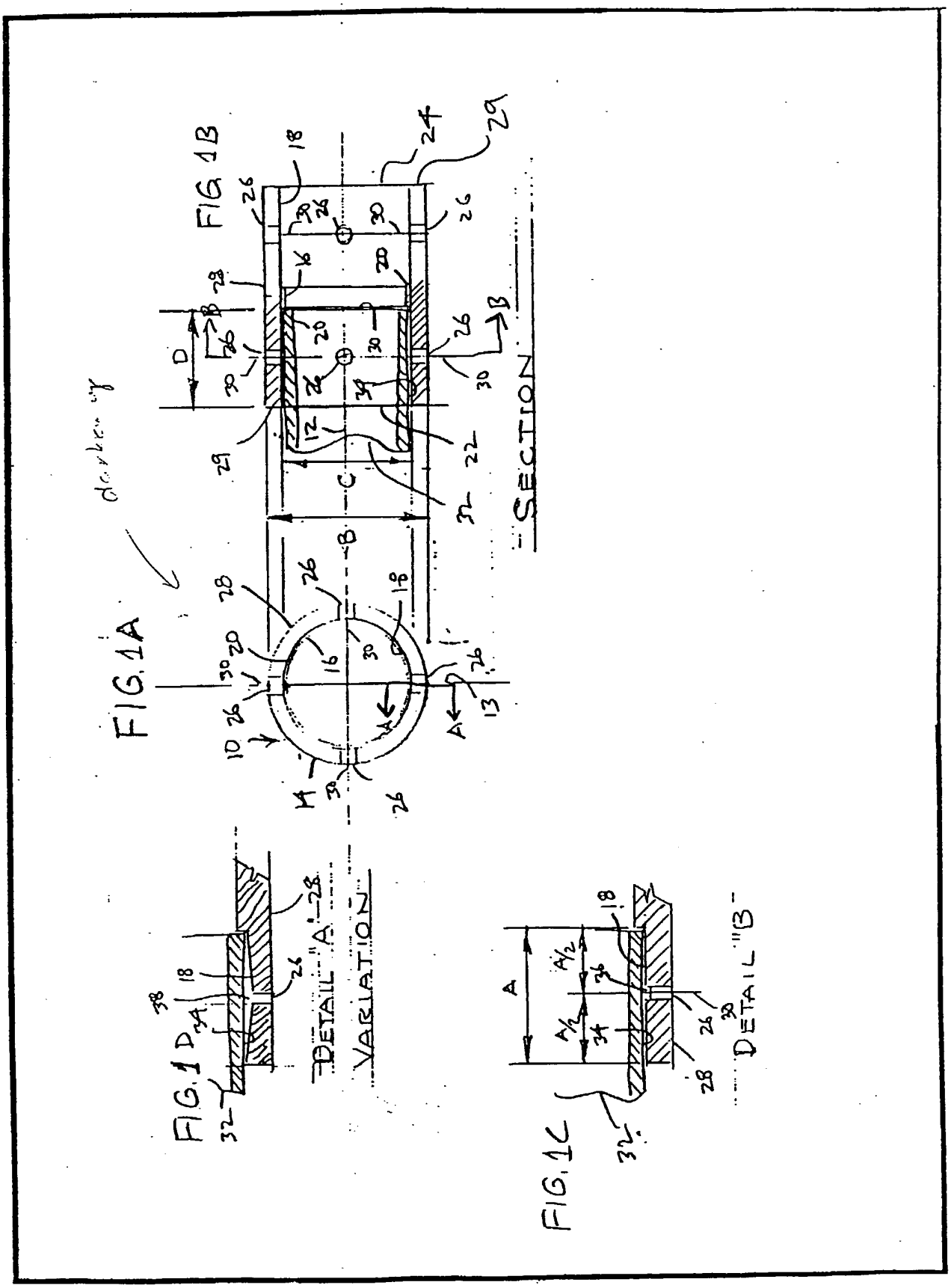
FIG. 1A
FIG. 1B
SECTION
FIG. 1C
DETAIL "A"
VARIATION
DETAIL "B"

FIG 2B

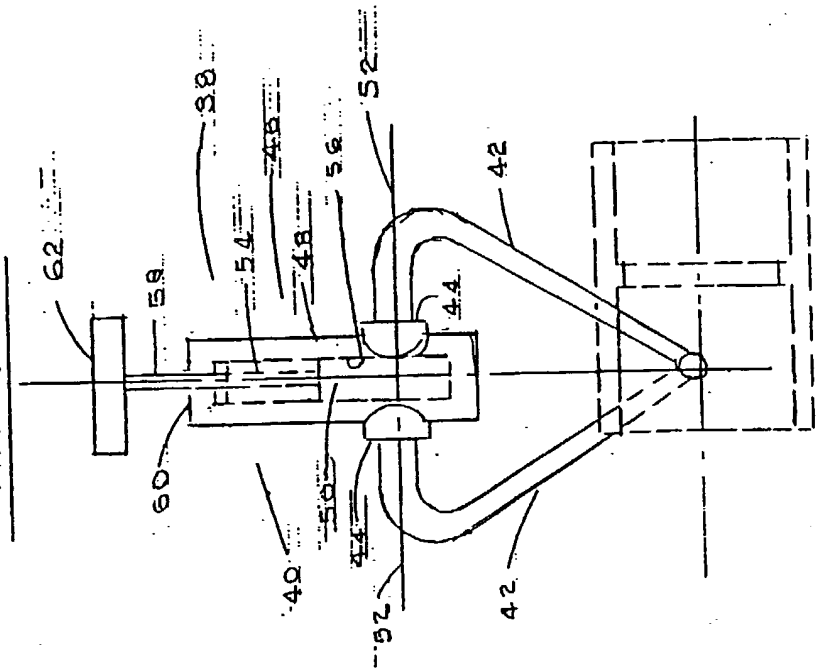
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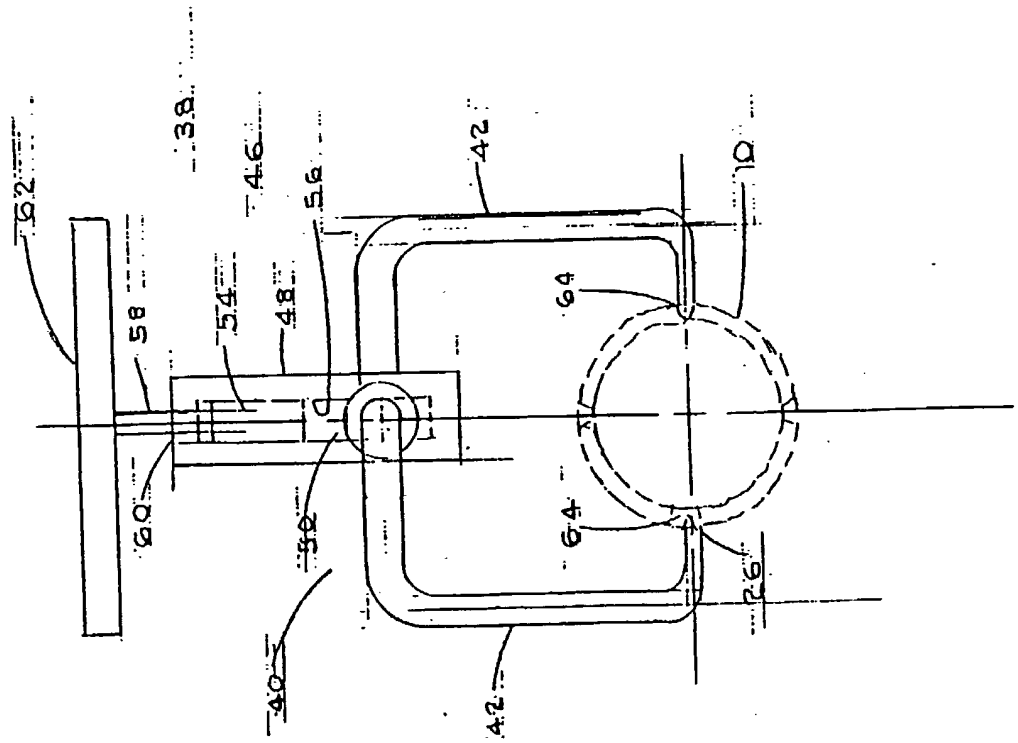
FIG 2A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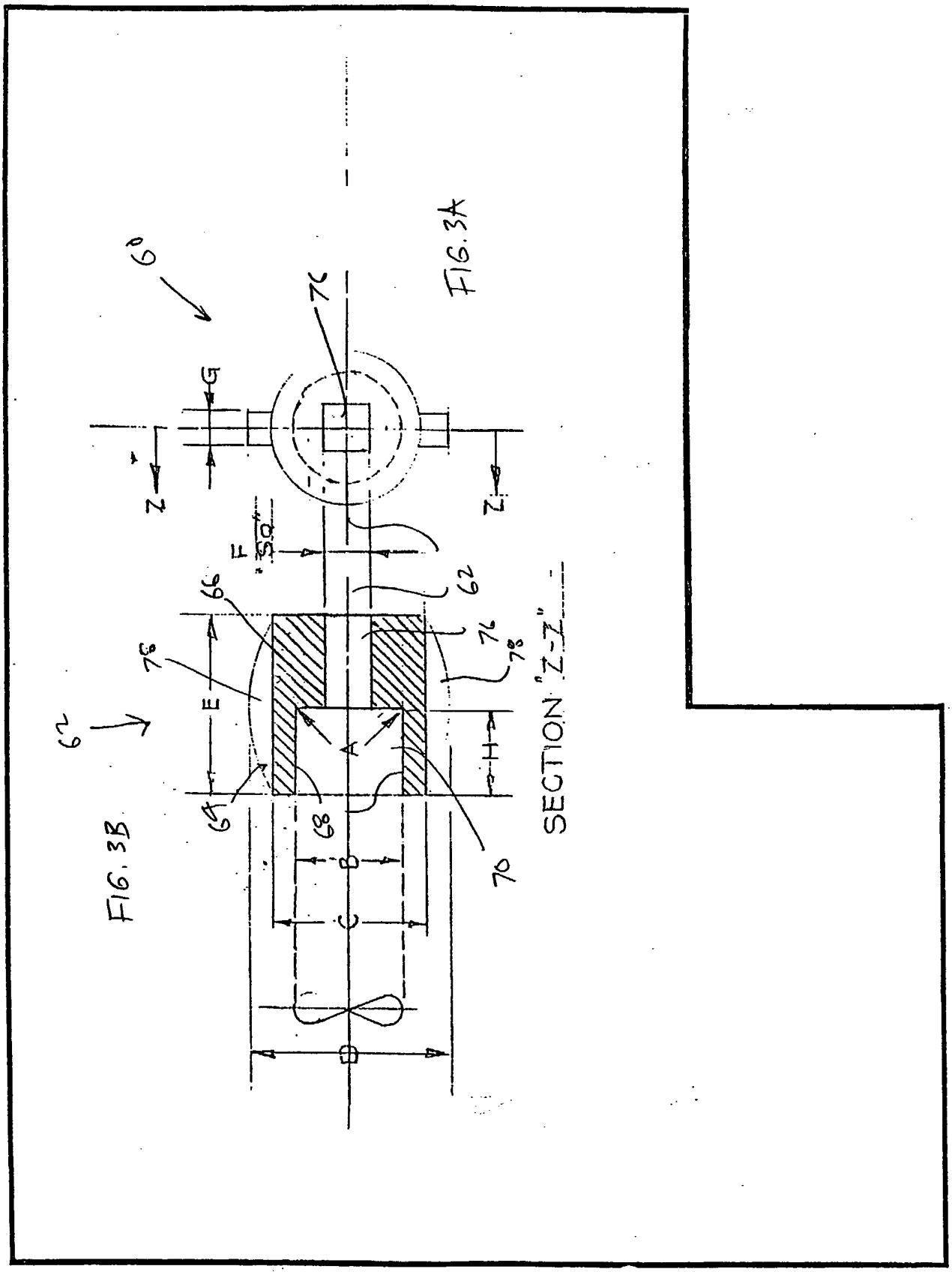

FIG. 3A

FIG. 3B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/09885

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B32B 31/00, 31/06
US CL :156/305, 578, 294; 264/262
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 156/304.2, 305, 578, 294, 257; 264/262

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS: pipe, tube, hole, holes, adhesive, glue, bonding, fitting, joint

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US,A, 1,946,619 (FURMAN ET AL.) 13 February 1934, pg. 2, line 76 - pg. 3, line 123.	1-22
Y	US,A, 3,977,704 (MEYER) 31 August 1976, col. 3, lines 37-40.	1-22
Y	US,A, 4,434,125 (LAVENDER ET AL.) 28 February 1984, col. 4, lines 46-49.	1-22
Y	US,A, 4,588,467 (TANI ET AL.) 13 May 1986, col. 3, lines 3-4.	1-22
Y	US,A, 3,491,182 (HUNDER ET AL.) 20 January 1970, col. 3, lines 33-43.	3, 11, 14-16, 18-19, 21-22

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search NONE	Date of mailing of the international search report DEC 02 1994
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer DAVID A. SIMMONS Telephone No. (703) 308-1972

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/09885

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US,A, 3,480,964 (SILER) 25 November 1969 col. 3, lines 32-43.	3, 11, 14-16, 18-19, 21-22